

# PATENT SPECIFICATION

(11) 1 234 794

DRAWINGS ATTACHED

- (21) Application No. 28750/68 (22) Filed 17 June 1968  
 (31) Convention Application No. 8513 (32) Filed 15 June 1967 in  
 (33) Switzerland (CH)  
 (45) Complete Specification published 9 June 1971  
 (51) International Classification G 07 d 7/00  
 (52) Index at acceptance G4X 6



## (54) DEVICE FOR TESTING THE AUTHENTICITY OF BANK NOTES

(71) We, SODECO SOCIETE DES COMPTEURS DE GENEVE, of 70 Grand Pre, 1200 Geneve, Switzerland, a Swiss Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a testing device for an apparatus which checks the authenticity of bank notes, in particular for bank note exchanges and automatic dispensers. This device is intended to examine the bank note to be checked, basing itself on the presence or the absence of a mark of authenticity.

The characteristic used in accordance with the invention resides in the presence or in the absence of a metallic thread incorporated in the paper of the note and the testing device according to the invention consequently detects if such a thread is present or not in the paper of the note to be checked.

According to the present invention, a testing device for apparatus for checking the authenticity of a bank note, the device comprising a pair of spaced, aligned electrodes forming part of a capacitor system responsive to the presence or absence of a metallic thread in the bank note, an electrically conductive grill for supporting the bank note during testing so that the metallic thread, when present, overlies the electrodes and means in circuit with the electrodes for signalling the presence or absence of the metallic thread.

According to a preferred embodiment of the invention, the metallic grill is connected to earth and serving as a support for the bank notes to be checked while they are in their testing position, as well as at least two electrodes separated from one another and disposed directly above or below the plane of the note, the electrodes being located in a line approximately parallel to the direction of the thread which may be present in the paper, one of these electrodes being connected to a high-frequency generator, the other electrode being connected through an amplifier having

a high entrance impedance to a threshold stage with adjustable threshold value.

According to another embodiment, means are provided for detecting the presence of a metallic thread secured to the upper or lower surface of a bank note to be checked. The detecting means may be two pairs of feelers one or the other of the pairs of feelers being short circuited with the emission of a signal if a bank note having a metallic thread secured to its upper or lower surface is inserted in the device.

Embodiments of the invention will now be described, by way of example, reference being made to the Figures of the accompanying drawings, in which:—

Fig. 1 is a schematic view from above the grill serving to support the bank note to be checked with the electrodes as well as the simplified mounting of the assembly.

Fig. 2 is a schematic cross section through a bank note with a metallic thread incorporated in the paper, placed on the support of Fig. 1 in a testing position;

Fig. 3 is a top schematic view of a pair of feelers for detecting a metallic wire applied to the surface of a counterfeit bank note by gluing;

Fig. 4 is a cross section of Fig. 3 showing the pair of feelers disposed on the upper part and the lower part of the bank note;

Fig. 5 is a modification of the assembly according to Fig. 1 with two pairs of electrodes.

As shown in Fig. 1, the support on which will be applied or on which can be moved the bank note during testing is constituted by a metallic grill 1 electrically connected to earth, which grill, has the shape of an H whose cross or transversal branch is designated by 1a. At a certain distance one from the other and symmetric relative to branch 1a are disposed two electrodes 2 and 3 each in the form of a wire, which wires are geometrically located on a common straight line perpendicular to branch 1a. One of the electrodes 2 is connected to a high frequency HF generator operating, for example, with a voltage of about 3 volts and a frequency in

the order of 10-50 kHz. The other electrode 3 is connected through amplifier V which has a high input impedance to an emitter stage of threshold value stage T with adjustable threshold value. The output signal of the threshold value stage is transmitted to a bi-stable flip-flop stage FF.

The bank note 4 containing metallic thread 5 is shown in a testing position in Figure 2 on grill 1, the thread 5 incorporated in the paper being located at a certain height relative to an imaginary straight line joining the two electrodes 2 and 3 and parallel to this straight line.

The two electrodes 2 and 3 constitute an electric condenser whose capacity is determined by the distance between these two electrodes 2 and 3 and by the dielectric located in the field created between the two electrodes and transmitted through the note during the testing operation. The use of a grill connected to earth additionally has the advantage that on the one hand, the dispersion of the electric field is diminished and on the other hand, owing to the fact that the branch 1a, of grill 1 is between two electrodes there is obtained a configuration which, from the electric point of view, corresponds to two condensers connected in series. A condenser is constituted by electrode 2 and the branch 1a of grill 1 while the other condenser will be formed by the branch 1a of grill 1 and electrode 3. The relationship between useful effect over disturbance of the testing device is thus increased owing to the series assembly of these capacitors.

If one compares the case where a bank note without metallic thread incorporated therein is placed in the testing position on grill 1, the capacity of the condenser system or possibly of the capacitive resistance of the high frequency circuit comprising the two electrodes 2 and 3 is substantially modified if in the representation according to Fig. 2, the two electrodes 2 and 3 are shunted by a metallic thread 5 located in the bank note 4. In the presence of such a metallic thread 5, there is constituted a system of condensers formed essentially by the series mounting of a condenser constituted by electrode 2 and thread 5 as well as a condenser constituted by thread 5 and electrode 3, the dielectric between the plates of the two condensers which effects the capacitance of the condensers is considerably reduced when compared with the case of the bank note without a metallic thread, since it is equal to approximately only half the thickness of the bank note. The total capacitance of the device is thus considerably increased in presence of a metallic thread, which consequently means a corresponding decrease in the capacitive resistance and for a given voltage of the high frequency generator,

an increase in the intensity of the current. There is used as amplifier V preferably a scaled emitter stage. The threshold value of stage T is selected in such a way that it be exceeded only when a metallic thread is present. In this case, the flip-flop stage FF sends to an indicating device A, supposing that the bank note to be checked contains a metallic thread, a signal signifying correctness, while if the threshold value is not exceeded, that is to say the absence of a thread, there occurs the emission of a counterfeit signal or still the presence of a signal of the threshold value stage T is interpreted as indicating a counterfeit.

If, however, the note to be checked does not contain any metallic thread, the signal emitted by stage T when the threshold value is exceeded will be naturally interpreted as indicating a counterfeit and if this value is not exceeded as indicative of authenticity.

In automatic checking systems in which the bank note is examined for several criterions by using several independent measuring units, the signal of the flip-flop stage FF can be evaluated in a logical assembly of known type which furnishes the result of the indication of the signals from all the testing units and indicating that the note is accepted or refused.

If by use of the testing device of the invention one examines bank notes containing at a given place a metallic wire which extends generally along the entire length or the entire width of the bank note, the device can be then constructed in such a way that the test be effected in only certain places in the bank note where the metallic thread, when it exists, is located, spaced above or possibly in alignment with the extension of the two electrodes 2 and 3, as is shown in Fig. 2. Besides, the test can also be effected in such a way that the bank note passes the testing system in a direction perpendicular to the orientation of the metallic thread (Arrow f) or still as in the example shown on Figs. 1 and 2, moved between grill 1 and electrodes 2 and 3. In this case, the exact positioning of the thread in the paper of the note is not critical, since it can be guaranteed with certitude that the thread, when it exists, follows the line connecting the two electrodes 2 and 3 and overlaps them considerably.

In the case where a genuine bank note is not provided with a metallic thread, a check must be provided to ensure that the thread does not exist. Owing to the fact, that a metallic thread, when it exists, is generally orientated transversally of the note, it suffices in this case to move the bank note across the system of electrodes in a direction perpendicular to the thread, that is to say, in the longitudinal direction. The testing device according to the invention can, however, be

modified according to the needs in such a way that the bank note passes once in the transverse direction and another time in the longitudinal direction and traverses the same system of electrodes or two identical systems of electrodes. It is thus possible to detect with a certitude a thread oriented in a transverse direction as well as a thread oriented in the longitudinal direction of the bank note.

It can happen with bank notes which have circulated for a long time and which are frequently folded that the thread incorporated therein is broken. If, during a test, the part of the thread which is broken occurs in the testing zone of the electrode system, the indication given may be erroneous since the electrically conductive path formed by the wire inside the paper, that is also inside the dielectric of the condenser is interrupted. To avoid errors due to such breaking of the thread, the testing device of Fig. 1 has been modified according to the example illustrated in Fig. 5 in order to provide two pairs of electrodes 2, 3 and 2a, 3a which extend in the direction of the metallic wire to be identified, pairs which in the example under consideration are connected in parallel. Electrodes 2 and 2a are once again connected to a high voltage generator and electrodes 3 and 3a to a threshold value stage through an amplifier as in the example shown in Fig. 1. Grill 1 is then modified in such a way that earth connection is located nearly in the middle of the distance between the electrodes of each couple. If the system of electrodes shown in Fig. 5 from above is passed by a bank note in the direction of arrow *f* and a metallic thread is in this note oriented perpendicularly to the direction of advance of this note, a thread, which for example, is broken in the zone between the electrode couple 2, 3, the non-operation of the device in the presence of the broken thread between electrodes 2 and 3 is compensated for by the two other electrodes 2a and 3a spaced from the zone of rupture of the thread during passage of the thread and that the variation in capacity required to trigger the operation of the threshold value stage still occurs. The probability that it could be broken in two places in zones of the two couples of electrodes is practically negligible. However, for still greater safety in the presence of several ruptures in a thread, it is possible to position a greater number of pairs of electrodes distributed along the entire length of the thread to be identified.

The geometry and the electric assembly of the system of electrodes shown in Fig. 5, where the two pairs of electrodes are disposed in the direction of movement of the note and where the corresponding electrodes of the pairs are connected in parallel to a

common high frequency generator or to a common amplifier can naturally be modified within the scope of the invention. It is for example possible to position several pairs of electrodes in series and it is also possible to provide for each pair of electrodes distinct circuits for measuring the capacitance.

To prevent that a counterfeit bank note comprises a metallic thread secured solely on the upper or lower part thereof for example by gluing in order to imitate an authentic note made with a metallic thread, the testing device according to the invention is modified preferably by an additional checking connection shown schematically in Figs. 3 and 4, and based on the described checking of the capacity with emission of a signal characterizing the presence of a metallic thread. This checking system comprises two pairs of feelers 8a, 8b and 9a, 9b which explore the note on its upper and lower surfaces when it moves through the testing device and produces short-circuit when they meet a metallic thread 7 adhering exteriorly to the bank note. In Fig. 3, there is assumed that bank note 6 moves in the direction of the arrow and has on its upper part a thread 7 pointing perpendicularly to the direction of movement of the bank note. The two feelers 8a and 8b which are located in a circuit comprising relay 10 or other threshold value stage are in contact with the surfaces in question of the bank note and short circuited by the threads when the thread 7 passes through the feeler. There results, through the agency of unit 10, the release of a counterfeit signal or the emission of a signal which is transmitted logical evaluation system. As indicated in Fig. 4, an identical couple of feelers 9a and 9b explore the lower surface of the bank note which moves in the direction of the arrow to detect also on this surface the possible presence of a metallic thread.

#### WHAT WE CLAIM IS:—

1. A testing device for apparatus for checking the authenticity of a bank note, the device comprising a pair of spaced, aligned electrodes forming a part of a capacitor system responsive to the presence or absence of a metallic thread in the bank note, an electrically conductive grill for supporting the bank note during testing so that the metallic thread, when present, overlies the electrodes and means in circuit with the electrodes for signalling the presence or absence of the metallic thread.

2. A device as claimed in claim 1, in which the grill has a generally H-shape, the cross branch of the H extending laterally across the space between the two electrodes, the grill being connected to earth.

3. A device as claimed in claim 2, in which the electrodes are located on a common,

straight line, perpendicular to the cross branch.

4. A device as claimed in claim 1, 2 or 3, in which one electrode is connected to a high frequency generator and the other electrode is connected through an amplifier having a high input impedance to an emitter stage of a threshold value stage whose output is connected to a bi-stable stage.

5. A device as claimed in claim 1, in which means are provided for moving the bank notes passed the device, in a predetermined direction, two pairs of electrodes being provided and arranged in the direction of movement of the bank notes to be tested, an electrode of each pair being connected in parallel to a common high frequency generator.

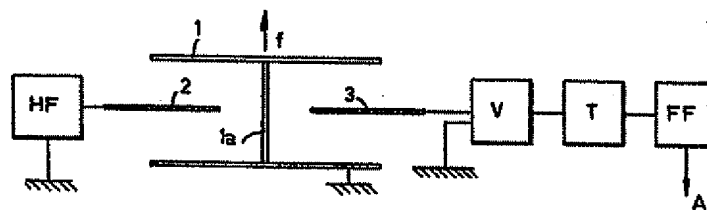
6. A device as claimed in any one of claims 1 to 5, in which means are provided for detecting the presence of a metallic thread secured to the upper or lower surface of a bank note to be checked.

7. A device as claimed in claim 6, in which the detecting means are two pairs of feelers one or the other of the pairs of feelers being short circuited with the emission of a signal if a bank note having a metallic thread secured to its upper or lower surface is inserted in the device.

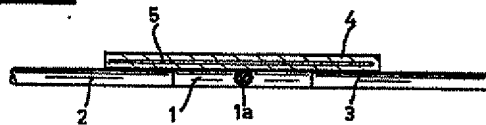
8. A testing device for apparatus for checking the authenticity of a bank note, constructed, arranged and adapted to operate substantially as hereinbefore described, with reference to and as illustrated in Figs. 1 and 2 or 5; or Figs. 1 and 2 or 5 when modified according to Fig. 3 and 4 of the accompanying drawings.

BUGNION & Co.,  
110 Kennington Road,  
London, S.E.11,  
Agents for the Applicants.

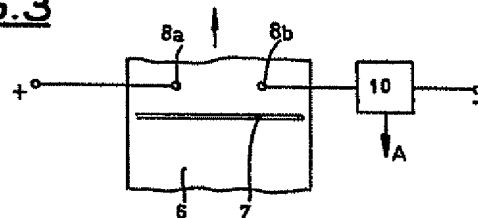
**FIG.1**



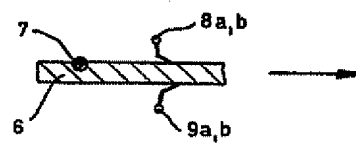
**FIG.2**



**FIG.3**



**FIG.4**



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COMPLETE SPECIFICATION

2 SHEETS

*This drawing is a reproduction of  
the Original on a reduced scale*

Sheet 2

FIG.5

